

there were, as well as those of M. Peaucellier and Mr. Hart, all particular cases of linkworks of a very general character, all of which depended on the employment of a linkage composed of two similar figures. I have not sufficient time, and I think the subject would not be suffi-

ciently inviting on account of its mathematical character, to dwell on it here, so I will leave those in whom an interest in the question has been excited to consider the original paper.

At this point the problem of the production of straight-

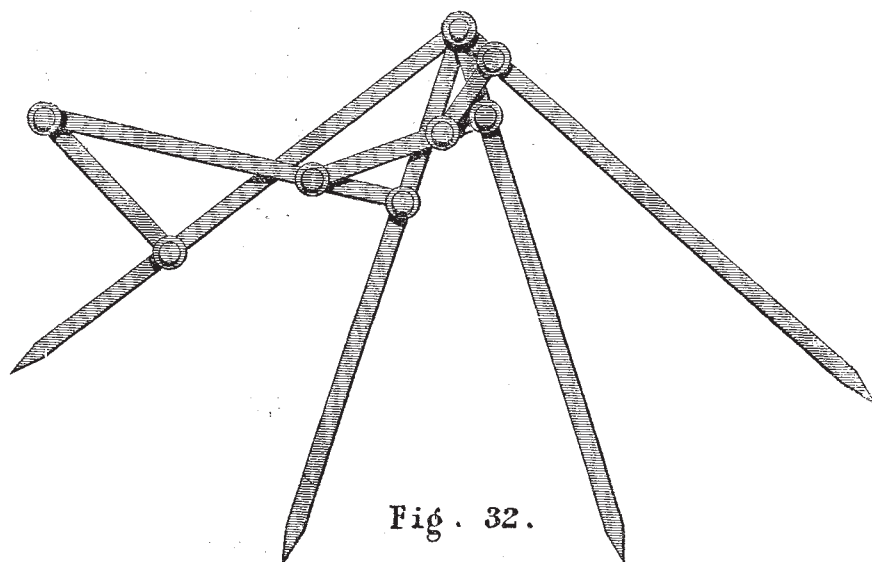


Fig. 32.

line motion now stands, and I think you will be of opinion that we hardly, for practical purposes, want to go much farther into the theoretical part of the question. The results that have been obtained must now be left to the mechanician to be dealt with, if they are of any practical value.

I have, as far as what I have undertaken to bring before you to-day is concerned, come to the end of my tether. I have shown you that we *can* describe a straight line, and *how* we can, and the consideration of the problem has led us to investigate some important pieces of apparatus.

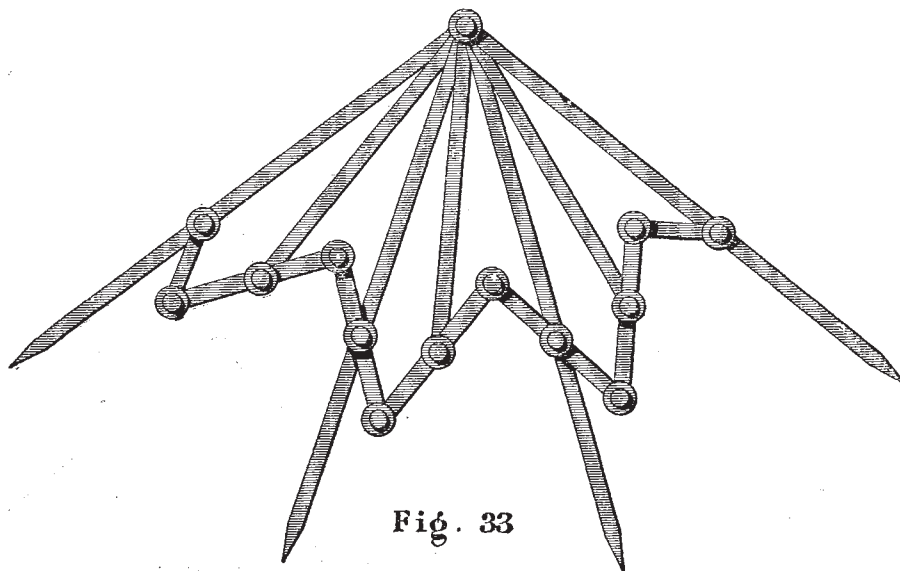


Fig. 33

But I hope that this is not all. I hope that I have shown you (and your attention makes that hope a belief) that this new field of investigation is one possessing great interest and importance. Mathematicians have no doubt done much more than I have been able to show you to day, but the

unexplored fields are still vast, and the earnest investigator can hardly fail to make new discoveries. I hope therefore that you whose duty it is to extend the domain of science will not let the subject drop with the close of my lecture.

BIOLOGICAL NOTES

THE TICHORHINE RHINOCEROS.—A number of the *Memoirs* of the Imperial Academy of Sciences of St. Petersburg just issued contains an elaborate article on the Tichorhine Rhinoceroses by the veteran naturalist,

Dr. J. F. Brandt. Dr. Brandt treats of two extinct species under this category, which he calls *R. antiquitatis* (i.e., *R. tichorhinus*, auctt.) and *R. merkiti*. With the latter he proposes to unite *R. etruscus* of Falconer. Remarks are added upon *R. leptorhinus* of Cuvier and other allied species. When we consider the number of valuable con-

tributions to science recently made by Brandt, Middendorf, Kowalewski, Radde, von Schrenck, and other distinguished names of the Academy of St. Petersburg, it becomes somewhat ridiculous to a naturalist to hear the oft-repeated assertion of the British patriot "that the Russians are as great barbarians as the Turks!"

OSCAR HERTWIG ON THE PHENOMENA OF FERTILISATION.—The last number (Vol. iii., Part 1) of the *Morphologisches Jahrbuch*, contains the second part of Oscar Hertwig's very important researches on the phenomena immediately preceding the cleavage of ova in the Echinoid *Toxopneustes*, in two genera of leeches, and in the amphibia. He has watched most carefully the process of fertilisation and the ova before fertilisation, and has examined them after the action of various reagents. His accounts are accompanied by very valuable figures. From his own observations, and a comparative study of other recorded facts, he appears to have made generalisations worthy of the attention of all biologists. The following is a brief summary of his conclusions. The unripe ovum is characterised by the possession of a germinal vesicle, distinguished from all cell-nuclei by its great relative size, by its definite membrane, its more or less fluid contents, and its possession of one or several nucleoli. The germinal vesicle in this signification does not become the nucleus of the first cleavage-sphere; in many animals it disappears long before fertilisation, in other cases during that process or during the ripening of the ovum. At any rate the germinal vesicle loses all its distinctive characters. The active nuclear substance, or a part of it, remains and forms a new nucleus of much smaller size, lacking a distinct membrane and true nucleoli. From a highly differentiated form is produced a primitive nucleus; instead of a germinal vesicle we have an ovinucleus. In *Toxopneustes* the retrogression of the germinal vesicle is accompanied by its movement to the outer surface of the yolk, where it disappears, with the exception of the germinal spot; the latter again reaches the centre of the yolk and becomes the nucleus of the ripe ovum. In Hirudineæ there is an accessory prelude to fertilisation, the budding-off of "directive bodies" immediately after oviposition. After this arises a spindle-shaped ovinucleus really derived from the breaking up of the germinal spot. In amphibia the exceedingly large germinal vesicle gets to the surface and disappears. Only a small portion, one or more nucleoli, passes over into the inconsiderable ovinucleus. The parts of the germinal vesicle not contributed to the ovinucleus seem no longer serviceable, and get transformed into the so-called excretory bodies and sphere. In Amphibia a mass of this kind appears as a yellowish covering over the dark pole of the egg. Like *Toxopneustes* appear to be Medusæ, Siphonophora, Ascidians, some Vermes, Arthropods, &c., possessing in the ripe and unfertilised ova a small homogeneous, membraneless nucleus in the middle of the yolk or on its periphery. The Hirudineæ resemble Gasteropods, Heteropods, Pteropods, and some Vermes. Here the ripe egg has mostly on its periphery a small spindle-shaped nucleus. In fishes and reptiles, as in the frog, there is a germinal vesicle with many nucleoli, some of which form the ovinucleus. After this stage Hirudineæ twice exhibit a budding from the surface of the ovum forming the so-called directive bodies, the ovinucleus contributing to them. The actual occurrences of fertilisation correspond very closely not only in animals but in plants. In *Toxopneustes* a single spermatozoon reaches the ripe ovum and is transformed into a small corpuscle, the sperm-nucleus, surrounded by a protoplasmic rayed figure. It travels in from ten to fifteen minutes to the central ovinucleus and is fused with it. In *Rana temporaria* the spermatozoon enters at the side of the excretory body and becomes like that of *Toxopneustes*, travelling to the ovinucleus and fusing with it. In Hirudineæ the spermatozoon enters subsequently to the budding of the first

directive body, and after transformation gets to the centre of the ovum and there remains till the budding of the second body. Then the ovinucleus travels to the centre and is apposed to and fuses with the sperm-nucleus, which has swollen considerably. Thus in these cases the cleavage-nucleus is formed by the union of the two sexually-differentiated nuclei.

INDIVIDUAL VARIATIONS IN ANIMALS.—At the last meeting of the St. Petersburg Society of Naturalists, Prof. Wagner made a communication "On the Individual Variations in Animals, their Causes, and Results." Pointing out that the appearance of new races, varieties, and species is rendered possible by the appearance, at all stages, of the development of life of individual variations, which variations give rise afterwards to more or less constant new forms, the Professor sketched the causes of these individual variations, exterior and interior, insisting especially on the importance of these latter. The causes of variability, he said, are not only the physico-chemical influences of the medium inhabited by the individuals, *i.e.*, the exterior causes, but also, to a very important degree, the interior causes, *i.e.* those subjective physiological, and therefore also psychological, individualities which characterise each individual, and which modify to a considerable extent the influence of exterior influences on each separate representative of the species.

A NEW CHEETAH.—At the meeting of the Zoological Society on Tuesday last, Mr. Sclater described a new species of cheetah, from South Africa, differing from *Felis jubata* in the fact that the whole body is covered with spots of a dark yellow instead of black, and at the same time is considerably more thickly covered with hair. Mr. Sclater proposed the name *Felis lanea* for this apparently new species.

NORTH AMERICAN LEPIDOPTERA.—Mr. William H. Edwards has published a catalogue of the diurnal lepidoptera of North America and Northern Mexico, supplementing the well-known work by Dr. Morris, printed some years ago by the Smithsonian Institution. He enumerates no less than 506 species. This is about equal to that of the previous catalogues, the additional new species being balanced by canceling names which were synonyms or not legitimately entitled to introduction in the North American list. The special object of Mr. Edwards is to bring about what he considers a satisfactory nomenclature, dissenting from the radical changes which he insists Mr. Scudder has made in his recent divisions and lists, in few of which he concurs.

A NEW SHELL.—Mr. C. R. Thatcher, the experienced conchological collector, has just returned to this country after a five years' collecting journey through China, Japan, Philippine Islands, and Australia. He has procured several new species of *Murex*, *Cancellaria*, and one wonderful specimen of an entirely new genus. This specimen was described at the meeting of the Zoological Society on Tuesday, June 5, by Mr. George French Angas, by whom it is proposed to give the name *Thatcheria*, in honour of its discoverer. It was the traveller's particular aim to procure specimens of the rare *Cypræa thatcheri* and *Voluta thatcheri*, both of which he found a few years ago, for which purpose he travelled many hundreds of miles into the interior of Japan, often at the risk of his life.

GEOLOGICAL NOTES

RARE MINERALS IN THE NORTH OF SCOTLAND.—The accidental use of a mass of granite for building purposes near Tongue, in Sutherlandshire, has led to the detection of several rare minerals, and of quite a remarkable number of species and varieties associated in the same mass of rock. From among the fragments of the boulder pieces of a bright green stone were sent to the